PERFORMANCE EVALUATION OF SOLAR POWERED PUMP BASED ON A DRIP IRRIGATION SYSTEM FOR SMALL SCALE AREAS USING NUCLEAR TECHNIQUES

By

ISRAA FATHY MOHAMED ELDEHN

B.Sc. Agric. Sc. (Agric. Engineering), Ain Shams University, 2011.

A Thesis Submitted in Partial Fulfillment
Of
The Requirements for the Degree of

MASTER OF SCIENCE
in
Agricultural Sciences
(Farm Power and Machinery Engineering)

Department of Agricultural Engineering
Faculty of Agriculture
Ain Shams University

2016

Approval Sheet

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ABSTRACT

Israa Fathy Mohamed Eldehn: Performance Evaluation of Solar Powered Pump based on a Drip Irrigation System for Small Scale Areas Using Nuclear Techniques. Unpublished M.Sc. Thesis, Department of Agricultural Engineering, Faculty of Agriculture, Ain Shams University, 2016.

Field experiments had been carried out in 2015 (January - May) at the Experimental Farm of Soil and Water Research Department, Nuclear Research Center, Atomic Energy Authority, located at Inshas City, Sharkia Governorate, Egypt which represents sandy soil conditions.

This study aimed to evaluate the performance of the solar water pumping system 15 minutes period all day long from 8:00 a.m. to 16:00 p.m. through three normal days in 2015 (January - May). Solar water pumping system performance was evaluated. Its correlation with solar radiation intensity, module efficiency, pumping system efficiency and overall system efficiency was measured. Soil water movement under drip irrigation system was carried out using neutron scattering meter to determine soil moisture before irrigation, after irrigation, after one hour irrigation and after two hours irrigation.

System evaluation was made for the photovoltaic pumping system by estimating solar radiation intensity, output generated power from photovoltaic (PV) and hydraulic power. PV modules were used as a power generator which convert solar radiation into electricity directly to operate water pumping system and pump water through drip irrigation system. The PV system was installed to irrigate 288 m^2 with a monthly daily average hydraulic power of 184, 157 and 141 W with generated electric power 1055, 1021 and 1003 W at 12:00 p.m. in May, April and March at 1085, 1073 and 1065 W/m^2 solar radiation intensity, respectively. The results show that the maximum overall efficiency, pumping system efficiency and module efficiency of the PV pumping system were 3.93%, 26.28% and 14.97%

respectively at solar radiation intensity 1085 W/m^2 in May, 3.29%, 22.49% and 14.64% respectively at solar radiation intensity 1073W/m^2 in April and 2.92%, 20.14% and 14.49% respectively at solar radiation intensity 1065W/m^2 in March.

Keywords: Solar energy; Solar pumping system; PV module efficiency; PV module temperature; Pumping system; Neutron scattering meter.

ACKNOWLEDGEMENT

I would like to express my deep thanks to **Prof. Mahmoud Ahmed El-Nono,** (late) Prof. Emeritus of Agricultural Engineering, Agricultural Engineering Dept., Faculty of Agriculture, Ain Shams University, for his kind supervision and valuable advices throughout this work.

I would like to express my deep thanks to **Prof. Mubarak Mohammed Mostafa,** Prof. Emeritus of Agricultural Engineering, Agricultural Engineering Dept., Faculty of Agriculture, Ain Shams University, for his kind supervision and valuable advices throughout this work.

I would like to express my deep thanks to **Dr. Ahmed Mahmoud Abdelmoneim Hegazi**, Lecturer of Agricultural Engineering, Dept. of Soil and Water Research, NRC, Atomic Energy Authority, for his kind supervision, valuable advices throughout this work and for his support, facilities, equipment supply through IAEA, RAF5071 project.

I would like to express my deep gratitude to **Dr. Kholood Mahmoud Mohamed**, Lecturer of Soil Science, Dept. of Soil and Water Research, NRC, Atomic Energy Authority for kind help and valuable advices throughout this work.

Thanks to **Dr. Mohamed Fathy Kassab**, Lecturer of Agricultural Engineering, Dept. of Soil and Water Research, NRC, Atomic Energy Authority**,** for his help.

Also my parents that have given me their obvious support, patience, loving encouragement and love throughout my life for which my simple expression of thanks does not suffice.

I am sincerely thankful to all staff members of Dep. Agricultural Engineering, Faculty of Agriculture, Ain Shams University.

Many thanks to all staff members of Soils and Water Research Department, NRC, Atomic Energy Authority, for their valuable help during carried out the experiments of this work.

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LIST OF ABBREVIATIONS

Abbreviation	Definition
A	Ampere.
AC	Alternative current
A_{PV}	Photovoltaic array area, (m^2)
Cp	Temperature coefficient of maximum power
DC	Direct current
I_{mp}	Maximum point output current, (A)
I-V	Current and voltage characteristics for the PV array
η_{all}	Overall system efficiency, (%)
η_{PS}	Pumping system efficiency, (%)
η_{PV}	Module efficiency, (%)
P_h	Hydraulic power, (W)
P_i	Input power, (W)
P_{max}	Maximum rated power of PV module, (W)
P-N	Positive and negative junction
P_o	Output power of photovoltaic array, (W)
PV	Photovoltaic
PVGS	photovoltaic generation system
PVP	Photovoltaic pumping system
PVWP	Photovoltaic water pumping system
Q	Pump discharge, (m^3/hr)
R_S	Solar radiation intensity, (W/m^2)
STC	Standard test conditions
TH	Total head, (m)
T_m	Module temperature, (^oC)
V	Volt
V_{mp}	Maximum point output voltage, (V)
W_p	Watt peak electric power